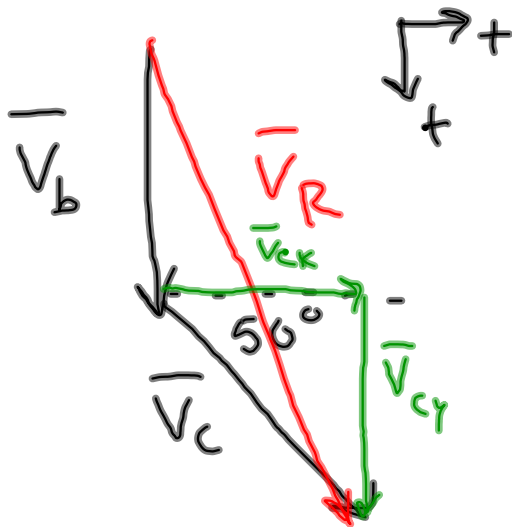


River Problem:

- Vector problem because boat and current both have velocity
- We can find net velocity, displacement, and time

River and Ramp Problems 3.27.12 CP Physics

As a boat travels 3.33 m/s due south, there is a current pushing 2.22 m/s at 50 degrees south of east. What is the resultant speed and direction of the boat?



$$V_{bx} = 0 \text{ m/s}$$

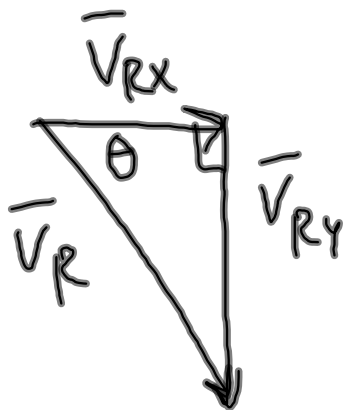
$$+ V_{cx} = +1.4 \text{ m/s}$$

$$V_{Rx} = 1.4 \text{ m/s}$$

$$V_{by} = +3.33 \text{ m/s}$$

$$+ V_{cy} = +1.70 \text{ m/s}$$

$$V_{Ry} = 5.03 \text{ m/s}$$



$$V_R = 5.22 \text{ m/s}$$

$$\theta = 74.5^\circ$$

S of E

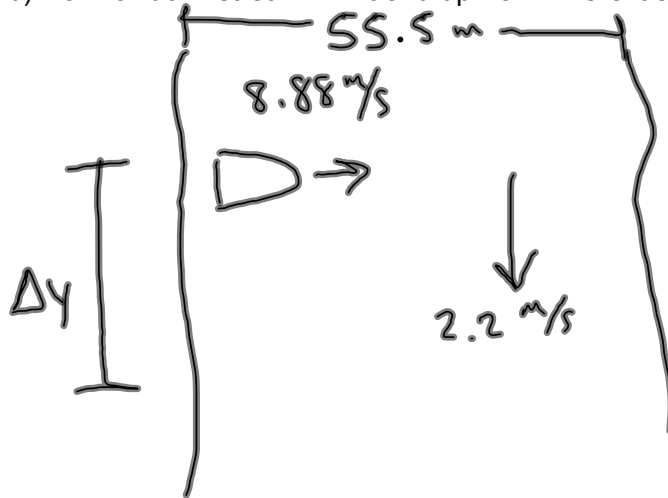
$$\vec{V}_R = 5.22 \text{ m/s @ } 74.5^\circ \text{ S of E}$$

River and Ramp Problems 3.27.12 CP Physics

A boat travels due east at 8.88 m/s. There is also a 2.2 m/s current south acting on the boat. The river is 55.5 m wide.

a) How long will it take the boat to cross the river?

b) How far downstream will it end up from where it started?



$$a) \quad v_x = \frac{\Delta x}{\Delta t}$$

$$\Delta t = \frac{\Delta x}{v_x} = \frac{55.5 \text{ m}}{8.88 \text{ m/s}} = 6.25 \text{ s}$$

$$b) \quad v_y = \frac{\Delta y}{\Delta t}$$

$$\Delta y = v_y \Delta t$$

$$= (2.2 \text{ m/s})(6.25 \text{ s})$$

$$= 13.9 \text{ m}$$

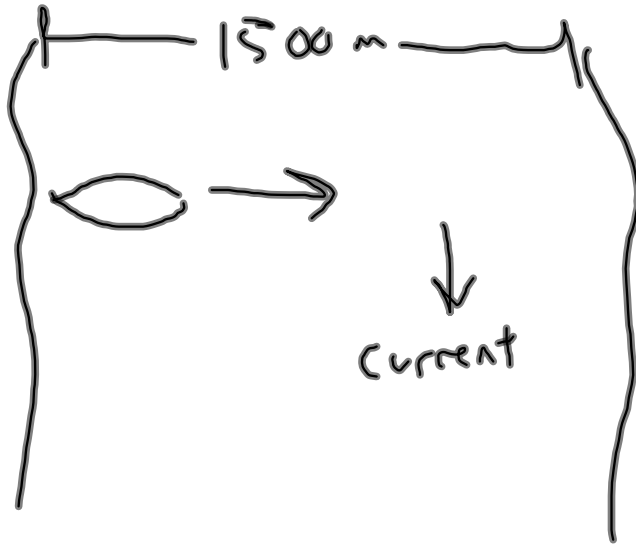
* Another way to solve would be to use velocity and displacement triangles.

River and Ramp Problems 3.27.12 CP Physics

A boat travels due east at 14 m/s. There is also a 8.9 m/s current south acting on the boat. The river is 1500 m wide.

a) How long will it take the boat to cross the river?

b) How far downstream will it end up from where it started?



$$a) \quad v_x = \frac{\Delta x}{\Delta t}$$

$$\Delta t = \frac{\Delta x}{v_x}$$
$$= 107 \text{ s}$$

$$b) \quad v_y = \frac{\Delta y}{\Delta t}$$

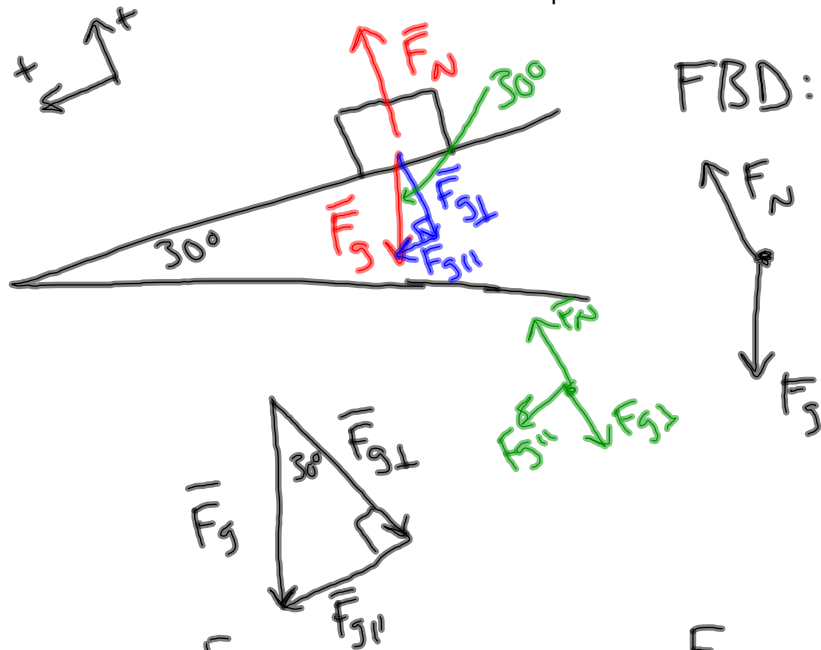
$$\Delta y = v_y \Delta t$$
$$= 953 \text{ m}$$

Ramps:

- Use Newton's second law to find forces, acceleration, and (if use friction equation) coefficient of friction.
- Use parallel and perpendicular directions
- Mutually orthogonal meaning two axis that are perpendicular to each other

River and Ramp Problems 3.27.12 CP Physics

A 20 kg box is on a frictionless ramp that is angled 30 degrees above the horizontal. What is the box's acceleration as it moves down the ramp?



$$\sin(30^\circ) = \frac{F_{g\parallel}}{F_g}$$

$$\cos(30^\circ) = \frac{F_{g\perp}}{F_g}$$

$$F_{g\parallel} = F_g \sin(30^\circ)$$

$$F_{g\perp} = F_g \cos(30^\circ)$$

$$\sum \bar{F}_{\parallel} = m \bar{a}_{\parallel}$$

$$\sum \bar{F}_{\perp} = 0$$

$$F_{g\parallel} = m a_{\parallel}$$

$$F_N - F_{g\perp} = 0$$

$$F_N = F_{g\perp}$$

$$a_{\parallel} = \frac{F_{g\parallel}}{m}$$

$$= \frac{F_g \sin(30^\circ)}{m}$$

$$F_g = m a_g$$

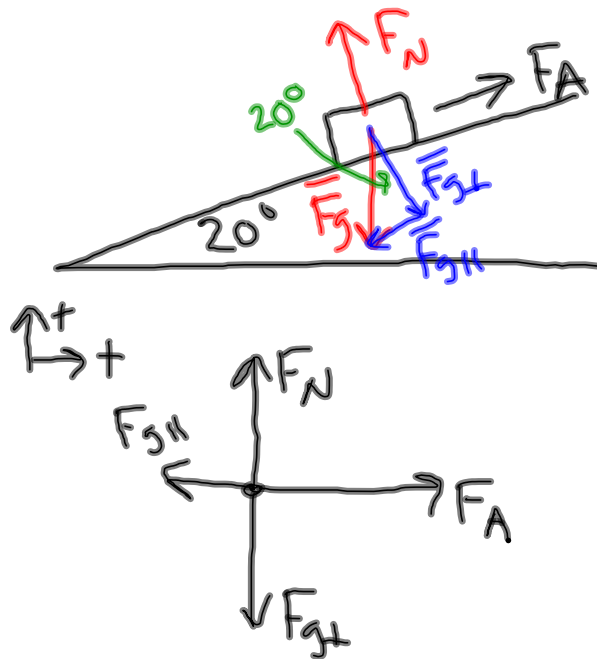
$$= \frac{m a_g \sin(30^\circ)}{m}$$

$$= (9.8 \text{ m/s}^2) \sin(30^\circ)$$

$$= 4.9 \text{ m/s}^2$$

River and Ramp Problems 3.27.12 CP Physics

A box of mass 5 kg is on a frictionless ramp that makes an angle of 20 degrees above the horizontal. The box is pushed up the ramp with a force of 80 N. What is the acceleration of the box as it moves up the ramp?



$$\sum F_{\parallel} = ma_{\parallel}$$

$$F_A - F_{g\parallel} = m a_{\parallel}$$

$$F_{g\parallel} = F_g \sin(20^\circ)$$

$$= mg \sin(20^\circ)$$

$$= 16.75 \text{ N}$$

$$a_{\parallel} = \frac{F_A - F_{g\parallel}}{m}$$

$$= \frac{80 \text{ N} - 16.75 \text{ N}}{5 \text{ kg}}$$

$$= 12.65 \text{ m/s}^2$$

River and Ramp Problems 3.27.12 CP Physics

A 5.5 kg suitcase is at rest on a ramp that is angled 22.0 degrees above the horizontal. What is the coefficient of friction between the suitcase and the surface of the ramp?